BULLETIN Nos. 15 & 16

Vol. II

1926-7

Published October 28th, 1927

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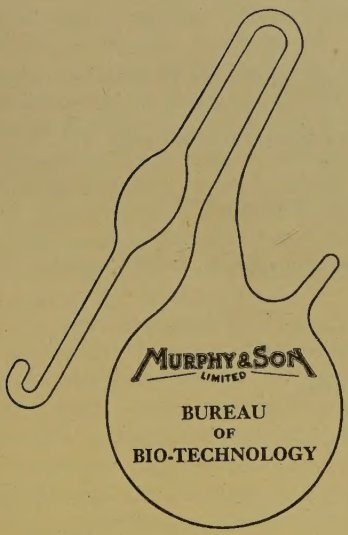

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On the Absorption of Odours by Beer

THERE is no beverage so peculiarly sensitive to manipulation and environment as Beer, and there is no person so exacting as the beer drinker. If his whisky and soda is not quite up to the mark, the whisky is too new or the soda water is inferior. If his glass of wine shows any turbidity someone has been stupid enough to shake the bottle. If, on the other hand, his glass of beer is not perfect, sparkling and foaming, or if its flavour is in the least degree abnormal, it is nobody's fault but the brewer's and due to no cause but the brewer's neglect. The sensitivity of beer causes the brewer to live in a more or less chronic state of worry. If the beer is flat or dull anyone can see it; if it is thin anybody can detect it, but if its flavour is ever so slightly "off," then it is that his worries reach a climax. When the flavour is normal, he knows that it is due to his malt and hops, but when it is abnormal he can do nothing but speculate.

Slight variation in flavour is of all defects the most difficult to locate; the characteristic "woody" or "mouldy" flavour due to the cask is another matter—here there is tangible or definite reason for it—but whenever it cannot be ascribed to the cask or fermenting vessel it is practically impossible to diagnose it, and we begin to wonder whether anything can have accidentally got into the beer during brewing operations, or whether the yeast was at fault, or anything wrong with the hops or malt, whether any foreign seeds had found their way along with the malt into the mash-tun, or a dozen other conjectures, probably blaming everything but the right thing.

We know that beer from a "fusty" cask will taste fusty, but that is because the beer has been *in actual contact* with the fusty surface, and as fustiness is due to the action of mould-fungi on wood, we are entitled to infer nothing more than that moulds will

give flavour to beer if they actually come into contact and remain with each other for some time ; we must qualify even this statement by adding that the moulds must be in a vegetative condition, for mouldy malt (*F. E. Lott. Jour. Fed. Inst. Brewing*, 1899, pp. 2-19) does not *directly* communicate any flavour to the finished beer.

A mouldy flavour is sometimes present in beer when it cannot be ascribed to contact with fusty wood : this remark applies to both cask and bottled beer, and it is desirable to enquire in these cases also whether it is a question of *actual contact* or of mere *absorption*. If beer be stored in a cellar reeking strongly of mould, will the reek be absorbed during settling, or cleansing, or at any later time, if left unshived or only lightly shived ? It is easy to believe that this might very well happen, but in the case of bottled beer, where some bottles have the mouldy flavour, while others filled from the same cask have not, it cannot be an instance of absorption of reek. In most cases where a mouldy flavour develops in bottled beer it is traceable to the corks, and the spores existing in the interstices of the cork have commenced to germinate in the bottle. This would commence on the surface of the beer, and if there is no film nor any particles found on opening the bottle it is probably because they have fallen to the bottom, where they are quietly working their evil effects upon the flavour of the beer. Mouldiness of cask beer admits of a similar explanation : if the reek of mould is noticeable it signifies that the air is contaminated by mould spores or hyphæ which find their way into the beer through the lightly-shived bunghole and are enclosed in the cask, in fact they may even be enclosed in the superincumbent air after filling and stoppering a bottle.

The particular purpose of this note is to enquire whether beer can or can not acquire a flavour by *mere absorption of odour* without actual *contact* with the odoriferous material, and without biological infection, a question that has hardly received the attention it deserves. At all times the brewer is careful to get rid of stale yeast, spent hops, mash-tun grains, etc., and he has a dread of an unclean racking floor, manure heap, mistal or stable, etc. There are, however, quite a number of other possible "smells" inseparable from the conduct of a brewery, which do not worry him very much

so long as they are "clean smells"—that is, they do not carry germs of infection in their wake. The operations of painting and varnishing, disinfecting, laying an asphalt floor, heating wax lacquer, all involve emanations of more or less pungent character and of longer or shorter duration ; even the attempt to get rid of beetles by means of phosphorus paste may not be altogether without danger in more senses than one. In former times, when hardly anything but turpentine was used as a paint solvent and when bisulphite was the only disinfectant, the question was of much smaller importance than it is to-day, when paint solvents include naphtha, carbon disulphide, etc., and where there is a wide range of disinfectants of very penetrating odour. The amount of information at our command in regard to such substances is rather scanty, and what there is seems to be based more upon a common-sense objection to any strong "smell" rather than upon any set experiments with the definite object of elucidating the question.

Windisch (*Wochensch. Brau.*, 1896, p. 1117) noted a peculiar flavour supposed at first to be due to absorption, but proved later to have been caused by exposure on a cooler all through a summer night and with consequent contamination by bacteria which, suppressed during fermentation, had tainted the flavour of the finished beer.

Lindner (*Wochensch. Brau.*, 1900, pp. 605-7) observed a different flavour which was due to the smoke from burning premises in the immediate neighbourhood ; but this might very well have been caused by direct transference of particles of soot. The only other direct reference we can find to *absorption* as distinct from *contact* odour occurs in Max. Toch's " Chemistry and Technology of Mixed Paints," where it is stated that walls painted with a tar paint communicated an odour resembling benzol or cresylic acid to the beer, and another paint—an aluminium bronze containing amyl acetate—also affected the flavour, but no information is given as to whether the tar was dissolved in benzol, cresylic acid or other solvent, and we do not know whether the beer was fermenting or quiescent or any particulars in regard to duration of exposure, etc. It therefore seemed worth while to make a few experiments to determine the effects of some of these volatile

substances when beers were deliberately submitted to their influence, but we considered that the first experiments should be made under exaggerated conditions of severity with the sole object of settling whether beers can or can not absorb odours to the detriment of their flavour.

Of the volatile constituents of the more common paints, varnishes and enamels, we have taken turpentine, naphtha, carbon disulphide and benzol ; as typical volatile disinfectants, sulphurous acid gas, carbolic acid, chlorine in the form of bleaching powder, and free chlorine in more concentrated form liberated from hypochlorite by the addition of acid to represent stale spent hops, mash-tun draff and an adjacent manure heap or cesspool sulphuretted hydrogen has been used and a beetle powder smelling strongly of phosphorus was included. In an experiment with mould, cultures of the common species, *Penicillium expansum*, were exposed in the Petri dishes in which they had been grown, after removing the covers.

The experiments consisted in fermenting a small bulk of wort in an atmosphere permeated by the odour under consideration, and as it was considered probable that active fermentation with its constant evolution of gas and its protective layer of surface-yeast might prevent absorption it was arranged that each should be racked in its own atmosphere. The procedure was as follows :— Two gallons of wort were pitched with yeast in an open glass jar, below which was placed a similar jar to serve as racking tank, the whole arrangement being set up in a suitable glass cupboard or nearly air-tight case. The beer was not racked until primary fermentation had quite finished, as judged by the cessation of gas evolution, and the racking was done by means of a syphon which transferred the now quiescent beer to the lower vessel in a thin stream exposed for several inches of its length to the atmosphere of the closed space in which it was fermented, so as to reproduce, in an exaggerated form, the actual conditions during the racking and storage in the brewery cellar.

The results are given in the following table :—

Odoriferous Substance	Fermentation	Appearance at Racking	Appearance after 7 Days in Bottle	Effects
TURPENTINE ...	Not affected.	Fairly bright.	Brilliant.	Decidedly fruity odour and flavour.
FREE CHLORINE	Dark heads and thin outcrop.	Rather cloudy and with a very peculiar metallic-looking film on surface of beer (not due to bacteria or any living organism).	Practically brilliant.	Very pronounced odour and flavour of bleach.
BLEACHING POWDER	Do.	Do.	Do.	Do.
BEETLE PASTE (PHOSPHORUS)	Not affected.	Bright.	Bright.	No noticeable indication of contamination.
CARBON DISULPHIDE	Do.	Do.	Do.	Free from odour and flavour.
SULPHURETTED HYDROGEN	Dark heads, very poor fermentation.	Very cloudy.	Dull.	No perceptible flavour nor abnormal odour.
MINERAL NAPHTHA	Not affected.	Rather cloudy.	Do.	Do.
GAS TAR ...	Good fermentation and outcrop, but top of heads considerably darkened.	Dull.	Dull, dark deposit.	Decided odour and flavour.
SULPHUR DIOXIDE (SO_2)	Fermentation and heads good.	Fairly bright.	Bright.	No odour, normal flavour.
BENZOLE	Fermentation not impaired.	Do.	Brilliant.	No odour, but pronounced flavour of benzole.
COAL TAR DISINFECTANT	Do.	Do.	Brilliant.	Decided carbolic odour and flavour.
MOULD	Do.	Bright.	Bright	Pronounced odour and flavour of "mould."

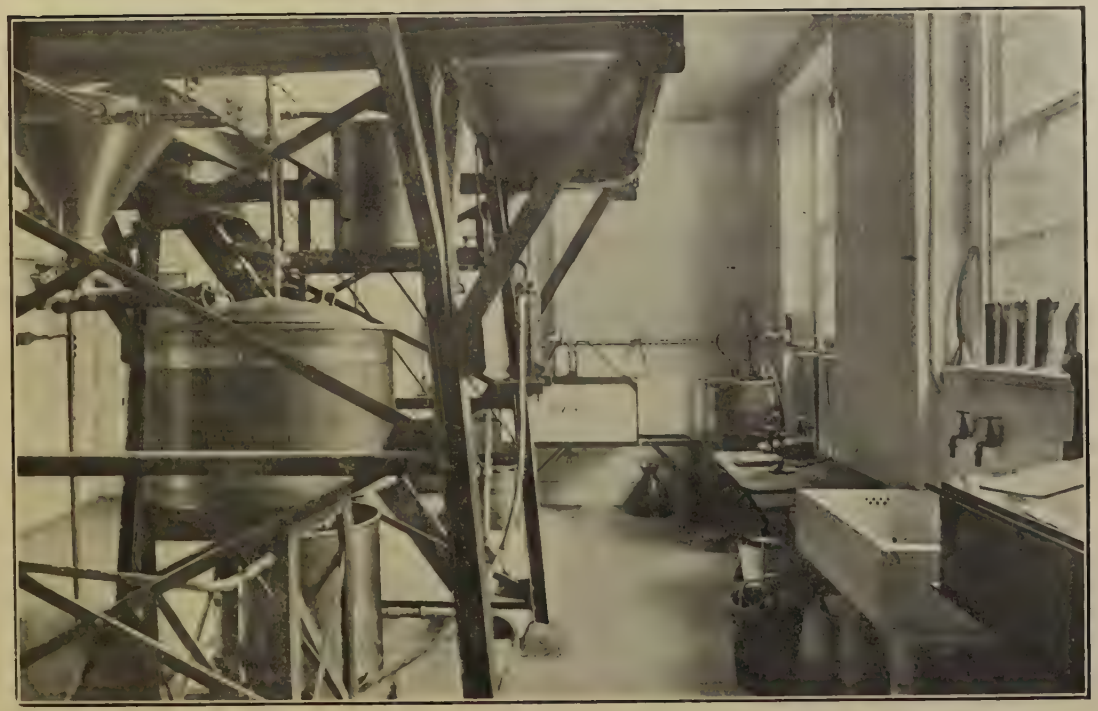
Very little comment upon these results is necessary. After a full appreciation of the risk of contamination by the presence of mould-growths the place of first importance should be given to the influence of Turpentine in communicating a decidedly fruity odour —an odour very often noticed in beer and frequently ascribed to the hops. A result of interest and some surprise is that so evil-smelling a substance as Carbon Disulphide had no effect upon the fermentation Outcrop, brilliance nor flavour ; even Sulphuretted Hydrogen did not affect flavour, although it lessened the outcrop, darkened the colour of the beer, subsequently producing a haze. Bleaching powder and soluble Hypochlorite evolving free chlorine gave results indicating that these substances should be used with extreme care. A word of warning may be given against the modern so-called water paints or distempers : formerly they were all prepared from inorganic materials and were then safe enough, but casein is now very largely used in their manufacture, and this substance is so prone to decomposition in any situation where walls remain damp on the surface that it must and does harbour all sorts of germs with the liberation of undesirable odours unless special measures for antiseption are taken.

The fermentations were carried out on brewery worts varying in original gravity from 1041° to 1044°, with the exception of the turpentine sample, which had an O.G. of 1050°. These attenuated normally down to a quarter gravity with the exception of those exposed to turpentine, phosphorus and sulphuretted hydrogen, which attenuated to rather less than two-thirds of their original gravities.

The beers produced in the experiment were all incubated for fourteen days at 27° C, and in no case where odour had been noticed in the racking sample did it disappear at any stage. The peculiar metallic film recorded in connection with the chlorine exposures persisted, and, indeed, in the case of the bleaching powder sample it was emphasised.

The general question of odour in the brewery is a much wider one than is covered by this note. Here we are only concerned with contamination by absorption and its influence upon beer, and

AN EXPERIMENTAL BREWING PLANT.
1.—Bird's-eye View.



AN EXPERIMENTAL BREWING PLANT.

2.—Grist-Hopper, Mashing Machine, Mash Tun and Underback, with two types of Fermenting Vessels

in this respect, although the experiment revealed little more than what might have been expected—viz., that some odours do and some do not communicate their characteristics to beer—in our own experience it has proved useful to know which among the common substances liable to be found in a brewery are those likely to affect the brewer.

ADDENDUM.—Quite recently, M. P. Petit (*Brasserie et Malterie*, 1927, 17, pp. 161-165) has published a paper of great interest to brewers and maltsters whose premises are situated in the vicinity of coke ovens and other fume-producing plant. In his opinion the erection of a coke oven within half a mile of a brewery constitutes a menace to the well-being of the beer on account of the possibility of the fumes being absorbed. Abnormal flavours produced in beer from such a source are not characteristic and may not be noticeable for some time after racking. M. Petit points out that what is true of the coke oven is true also of many other manufacturing operations from which odours emanate, and he advises maltsters and brewers to pay attention to such potential danger to their products.

A. J. MURPHY AND F. A. MASON.

An Old Recipe for Sweetening Casks

EVERYBODY must have listened to the complaint that beer is not what it used to be. If one takes the trouble to enquire closely into the nature of the old-time beer from recipes for brewings given in the Guides and Handbooks of the past, the ingredients will be found to include "grains of paradise," "copperas," "liquorice root," capsicum, ginger, salts of tartar, and some half dozen other substances, none of which would satisfy the requirements of our modern Ministry of Health. We are therefore entitled to agree that the modern beverage does not partake of its former character, and we are not sorry. Similar complaints against any

deviation from earlier practice are sometimes heard with reference to the maintenance of plant, especially when advocating methods of treatment designed to ensure a near approach of sterility. We have found a method of treating fusty casks used in "the good old days" in a book which must have enjoyed considerable popularity, as it ran into at least five editions. The book is entitled "The Innkeeper and Butler's Guide, or a Directory in the Making and Managing of British Wines; together with Directions for the Managing, Colouring and Flavouring of Foreign Wines and Spirits, and for Making British Compounds, Peppermint, Anniseed, Shrub, &c., &c." Fifth Edition. By John Davies, Leeds. Printed by George Wilson, 1807.

The title-page gives only a partial clue to its contents, as the volume also includes the making and "management" of Beer, Porter, Cider and Vinegar. In the Preface, among other things, the author states that "The very best and most approved Receipts which are at present in use, will be found in this Volume. I have sparred no pains in collecting them, during some years, while I have had those opportunities which few have enjoyed. I flatter myself that I may, without the imputation of vanity, say, that I know as much on this subject as any other man in the kingdom."

As John Davies said that, it might appear churlish to question his competency for dealing with cask plant, and we give his "receipt" as it is printed on page 52 of the "Guide." We think it carries its own argument in favour of modern methods of cask treatment.

To sweeten a musty cask.

Take some dung of a milking cow when it is fresh, and mix it with a quantity of warm water, so as to make it sufficiently liquid to pass readily through a large funnel; but previously dissolve in this water two pounds of bay salt, and one pound of allum: then put the whole in a pot on the fire, stirring it with a stick, when near boiling pour it into your cask, then bung it tight, and shake it well about for five or six minutes, as if rinsing it, and let it remain in for two hours, then take out the bung to let the vapor out; after which put in your bung again, and give it another stirring: in the end of two hours more, you may rinse it out with cold water, till it comes out perfectly clear; then have in readiness one pound of bay salt; and a quarter of a pound of allum boiled in a little water. Repeat this as you did the former, and when emptied it will be fit for use, or you may bung it up for keeping.

A Transit Tube for Yeast Samples

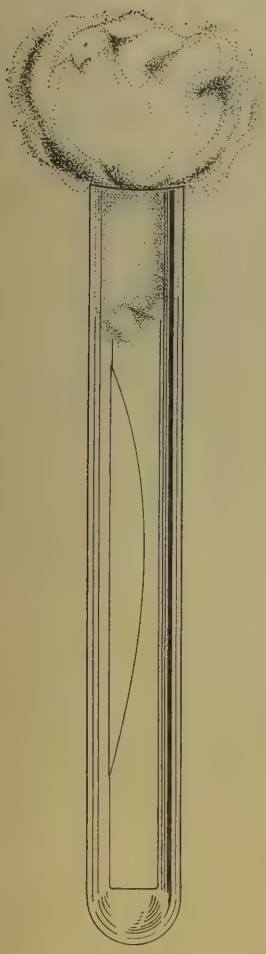


Fig. 32.

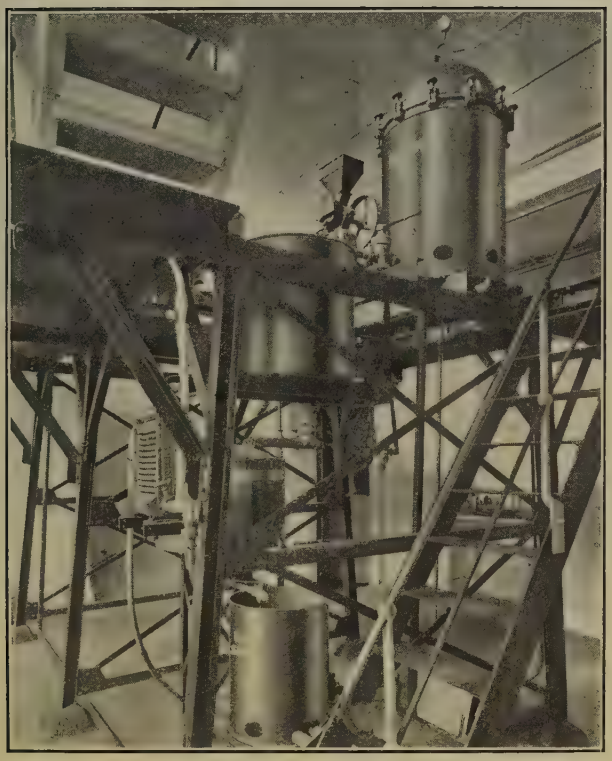
SAMPLES of pitching yeast are received at the Bureau in almost every conceivable kind of small glass container, including test tubes, phials and tumblers, and also occasionally spread upon filter or blotting paper. A simple application of the test tube, which, ordinarily, is an inconveniently narrow vessel for filling with yeast of pasty consistency and which does not permit of satisfactory withdrawal of a representative sample, is that in which a cotton plug is used for securing a strip of stiff absorbent paper. The tube prepared as illustrated is sterilised before use, after which it is only necessary to withdraw the plug, plunge the strip into the yeast to be sampled, and return to the tube, taking care to re-insert the plug securely in the mouth of the tube; the plug is best removed and replaced by a screwing movement. Samples taken in this way are not contaminated by contact with the fingers nor with any other non-sterile appliance, neither does the outside of the container become smeared, and it ensures the yeast reaching the laboratory in a representative condition and in the most convenient form for examination. Small as the sample may appear to be, it gives ample material for both microscopical examination and incubation tests. We prefer this method, and sterilised prepared tubes are forwarded to clients upon request.

An Experimental Brewing Plant

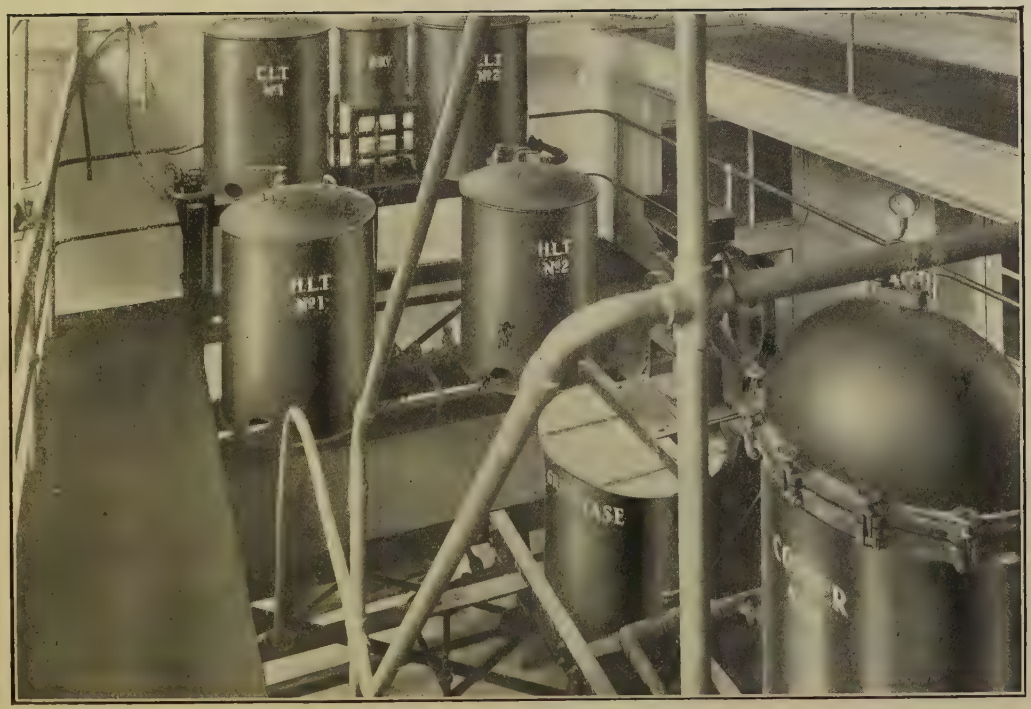
PROBABLY the first model brewery plant ever constructed by brewery engineers for a private laboratory in this country was erected for Mr. A. J. Murphy (our present Managing Director), in his Leeds laboratories, nearly thirty years ago. This plant included that fetish of the period—an open copper cooler, and it was in other respects an up-to-date plant which enabled us to carry into practice on a small works scale methods based on the results of laboratory experiments.

Great advance in the construction of brewery plant has been made during the last twenty years, a good deal of which is traceable to the necessity for stricter economy, not only in the actual brewing operations, but also in conserving the beer that is brewed by increasing its stability. To-day one sees in a brewery improved methods of cooling by the employment of deeper vessels presenting less surface area than formerly, or by the use of closed refrigerators of a type which permits of the wort being cooled down to pitching temperature without any possibility of aerial contamination. The yeast may be collected, pressed and stored in ice chambers instead of being kept in open tubs or other vessels, and there is scarcely any portion of a brewery plant in which some improvements have not been effected in that comparatively short period.

Economies in brewing, experiments in the production of beer of fuller palate, enhanced hop character, and greater than average stability, often entail changes in milling, adjustment of reaction in regard to the water supply, alterations of temperature in mashing and mash-tun manipulation, and many other excursions into the unknown which few brewers are willing to undertake, and as often as not the matter is referred to the laboratory.



AN EXPERIMENTAL BREWING PLANT.
3.—Underback, Pressure Copper, Hopback and Refrigerator.



AN EXPERIMENTAL BREWING PLANT.

4.—Cold and Hot Liquor Tanks, Mill, Grist Case and Pressure Copper.

We have found in the course of numerous investigations that there are many experiments which are much more satisfactorily carried out on a larger scale than is possible with ordinary laboratory apparatus, and there are at least two types of experiment in which the large scale method is absolutely essential. One of these is that in which the problem is to elucidate the relationship of the quality of a malt to the character of the beer that may be brewed from it, an aspect quite distinct from that of its analytical evaluation. For example, a case may be instanced in which a heavy contract for malt has been based upon sample and analytical certificate; the deliveries conform to the specification without, however, the brews in which they are used giving results quite up to expectations warranted by the analytical figures. It may or may not be the fault of the malt, but, whatever the reason, a problem is presented which in our experience is most readily solved by putting in a series of brews with the suspected and other materials, respectively, under conditions with regard to water, milling, mashing, filtration, refrigeration and fermentation approximating as nearly as possible to those obtaining in brewing practice at the particular brewery involved. The cost of a 50-barrel brew, for instance, with the Excise Duty, which has to be paid whether it turns out good or ill, runs into several hundreds of pounds, and although the experience gained might result in an economy in the long-run, there are few Managing Directors willing to take the risk of it not doing so. In a single-barrel brew produced in properly constructed plant the cost is but little greater than the Excise charges and it is capable of yielding all the information that is desired.

The second case is that in which, in these days of keen competition, it is necessary for a brewer to improve on the character not only of his own beer but also on that of his competitors, and this, also, can best be attempted in a plant with which operations of current practice can be accurately followed and controlled. It is a type of investigation in which theory helps but very little, and laboratory experiments not at all.

In 1925 it was found desirable to instal a new experimental plant on a more elaborate scale than our first model, and as a matter of general as well as of technical interest we include

photographs of the plant as erected in our London laboratories. The equipment includes hot and cold liquor tanks designed to respond to any kind of manipulation met with in brewery practice, so that experiments on the effect of boiling, adjustment of reaction, or of salinity can be readily made. The mill, mash-tun, copper, etc., are each constructed to give elasticity in their use in order to cope with any type of brewery practice.

A unique feature of the plant is its fermentation equipment. The fermentation vessels found in different breweries are constructed of various materials, including wood, slate, stone, cement, copper, aluminium and glass-lined iron, or steel. An astonishing influence is exerted upon fermentation and upon the yeast itself by the material of which the vessel is constructed. The question of metal as a material for fermentation vessel construction is a highly debatable one, and one that requires much experimental work before it can be left, and fermenting vessels of all the materials mentioned have been installed. Some of these have been duplicated with a view to demonstrating the value of lining materials as compared with the results obtained when the fermenting wort and yeast are in contact with the metal. The plant is operated by Mr. G. Jones (Diploma Member, Institute of Brewing; Mem. Operative Brewers Guild).

F. A. M.

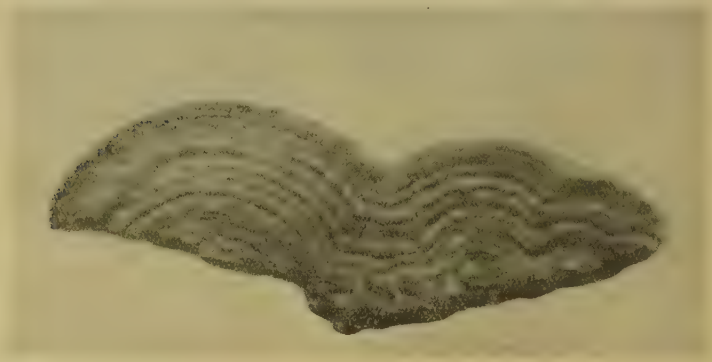


Fig. 33.

An Unusual Growth-form of *Monilia candida* in a Brewery

SOME very curious objects were received from a brewery, where they had been discovered in a fermenting vessel. One of them, cut into two pieces, the central portion having been removed for examination, is illustrated in Fig. 34. Identification was requested, and an explanation of their occurrence in a fermenting vessel was desired. The specimens had a brownish-grey colour, were flat on one side, irregularly rounded on the other. They ranged in size from 2 to 6 inches in length by 1 to 1½ inches in width; in section they were irregularly semi-elliptical, one-third to half an inch at their greatest thickness, and on sectioning they were found to be stratified in fairly regular layers, as is well shown in Fig. 33, which is a photograph made with an ordinary camera lens, enlarged three times.

Microscopical examination of the material indicated that it was a growth, wholly fungoid in nature, and one that must have taken a considerable time to reach its present proportions. There are some fungi which exhibit similar stratification in their structure, a good example of which is *Daldinia concentrica*, but this and the others all belong to the higher fungi to which our specimens could hardly be assigned. Experiments in the cultivation of the fungus were made with success and the organism proved to be the common mould fungus *Monilia candida*. This species, however, occurs normally as a thin, greyish-white, moist to a somewhat downy growth, and it developed in pure culture in exactly that way. The fungus is one of simple structure consisting of a mycelial growth giving rise to abundant yeast-like conidia, capable of developing in the atmosphere or when immersed in a saccharine liquid.

As no such solid, indiarubber-like mass of this fungus had been previously encountered, it was not very convincing proof that the brewery specimens were built up of this organism alone. Within a few days of receipt at the Laboratory the specimens on standing in a dry condition in Petri dishes were found to have developed a superficial, slightly farinaceous covering of conidia corresponding with those obtained in pure culture. A piece of the substance was then transferred to malt-wort and incubated for three days, after which it was again examined, when it was found that the conidia had all germinated *in situ*, producing a new growth of mycelial filaments. After removal to a dry dish it again developed conidia, and further experiments resulted in

FIG. 34

adding to the original specimen, new and extraordinarily compact stratifications, each of which consisted of a mycelial growth and its germinating conidial layer.

Having established identity the problem of its presence in a fermenting vessel had to be solved. Whilst it could grow in a fermenting brewery wort it could not develop either the size or the stratified condition during the six days normally occupied by the fermentation, at temperatures between 15° and 20°C, and between fermentations such drastic cleansing operations are carried out that it would be quite impossible for a body of this size to be left undetected. It was concluded therefore that the place of origin and the situation in which the specimens were found were not identical. As the specimens had a flat side it was obvious that they had grown on a flat surface, but it would be immaterial whether the growth was upwards or downwards in direction. It was assumed that they had not been deliberately introduced, and the probability was that they had fallen in from above. This proved to be the explanation, and subsequent inspection located their habitat on the boarded ceiling commanding the vessel. In this position the organism would be subjected to alternate periods of moisture and dryness incidental to brewery operations, and there they developed until some change of a minor catastrophic nature, such as the dropping of a weight above the boards, or of excessive drying of the matrix, caused their dislodgment.

F. A. M.

Notes

Giant Wood-Wasp in a Fermenting Vessel

A block of Kauri Pine, cut from a new fermenting vessel which had been constructed of this wood, was forwarded to the Laboratory for report on the nature of the worm causing the damage and the possibility of the introduction of the pest on our clients' premises since erection. The accompanying photographs give some idea of the extent of the damage which has been caused

Fig. 35.

by the larva of this giant wasp, *Sirex gigas*. Fig. 35 shows at full size a sectional view of the tunnels; Fig. 36, on a slightly reduced scale, the nature of the damage, including a diagonal boring at right angles to the main tunnels.

The larval life of this insect extends over a long period. It pupates in the tunnels excavated during the former period, and cases are known in which the insect has remained in the wood for some years before the emergence of the perfect insect. The writer has personal experience of one of these insects eating its way through a bale of cloth from the central board on which it was wrapped. It is a fearsome-looking insect, but one not likely to be encountered often in a brewery. The insect is not regarded as a British species, and the onus of its occurrence in the wood of a new fermenting vessel must be thrown on the builder.

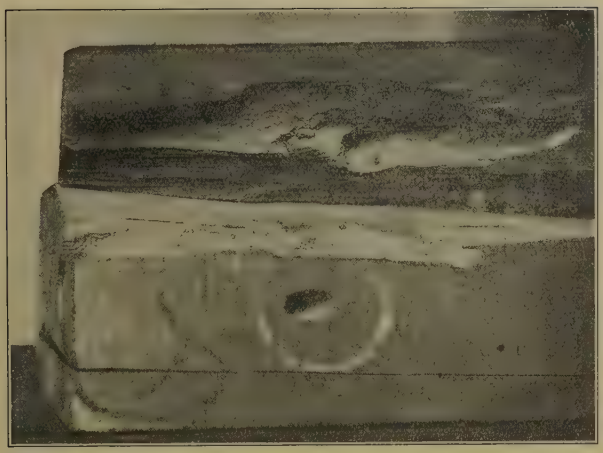


Fig. 36

Notes for Growers.

Many specimens of diseased plants, fruits, roots, etc., submitted to our F and G Department during the past year have been examined, after which suitable methods of control have been suggested. It is not always possible to ascertain the results obtained by following our advice, but a staff of representatives who confine their individual attention to certain well-defined areas of horticultural and agricultural practice—*i.e.*, the fruit-growing districts of the South-East, the South-West, Cambridgeshire, the Lea Valley, Hop-growing districts, etc.—enables us to assist materially in ensuring the correct applications of advice and to check the success or otherwise of the methods adopted. About 90 per cent. of the growers seeking advice adopt our methods and materials with considerable success, as ascertained either by their own reports or by the means mentioned above; the remainder is made up by those who lack courage necessary to break away from tradition and by a small percentage of enquirers whose specimens have already been submitted to others for purposes of confirmation or refutation. We are pleased to assist even the latter, but it should be appreciated

by senders of material that quite unsuspected traps await the unwary. No two leaves on a tree are exactly alike and two shoots from the same shrub may be attacked in one case by an insect and in the other by a fungus. A fruit grower who had been advised by one expert that certain shoots were attacked by a fungus, known as *Diaporthe perniciosa*, and by another that they were suffering from a "die-back" disease due to a species of *Cytospora*, has less cause for worry and complaint than have the mycologists who had to identify the fungus, and he may rest assured that the information received from each of them was quite sound, even if it appeared to be confusing; a good many fungi exhibit well-marked stages of development, each of which has received a different name.

Specimens received have included both fungous diseases and insect pests, as well as examples of physiological diseases and bacterial rots. Identification has sometimes been rendered difficult by reason of the small amount and unrepresentative condition of the material sent in, or by the absence of information regarding the circumstances under which a disease has been observed. For guidance in submitting specimens it may be pointed out that growers should select a typical example of the infected or insect-ravaged plant, and forward it in as complete a state as possible, although steps should be taken in packing to prevent the soil adhering to the roots from getting on to the stem and leaves of the plant. This applies more particularly to horticultural specimens and to vegetable crops; shoots, leaves, fruits and other portions of fruit trees and bushes should be sent at least in duplicate. Insects believed to be responsible for damage should accompany the host plant and should be packed in tin boxes. It is not necessary to pierce such packages, and where small insects are concerned it is a disadvantage to do so as the holes provide a ready means of escape. Information with regard to the extent of injury, times of appearance, and whether or not spraying or other measures have been taken against the pest is always helpful, and attention to these points will ensure a diagnosis and report with the least possible delay.

Insect *versus* Power.

A POWER-DRIVEN malt-crushing mill, of the type known as the "Two-high," constructed by a well-known British firm, was found to be working indifferently, gradually got worse, and finally stopped altogether, the usual power failing completely to operate the rollers. An investigation was made which resulted in the discovery of a tightly-packed mass of grain débris occupying what should have been an empty space inside the top of the mill. After removal the material was found to possess a very matted structure in which the particles of husk and malt flour hung together in large masses—a fragment is shown in Fig. 37. The cause proved to be of a biological nature, the condition of the material being the result of the activities of the well-known grain pest, the Mediterranean Flour Moth, *Ephestia kühniella*. On teasing out a little of the material all the life stages—eggs, larvæ, pupæ and perfect insects—were found. The three later stages appear in the photograph, Fig. 38. The moth is silver-grey in colour, with dark irregular markings on the wings. They fly at night and are frequently overlooked in a brewery. From 100 to 300 eggs are deposited by the female moth in almost any place where grain products are available for the food of their progeny. The larvæ are white, caterpillar-like grubs which spin fine silken cocoons in which the particles are enmeshed, as well indicated in the lower figures in the photograph.

Fig. 37.

Fig. 38.

"Little Drops of Water."

We were taught in our youth that these made up the mighty ocean, and we since learn that in some cases at anyrate it is an ocean of trouble. In a search for a source of infection by wild yeasts it was observed that a wooden beam situated high above a fermenting vessel acted as condensing surface from which there was an occasional drip into the tun below. One of the drops was caught on the prepared agar surface of a Petri dish, where it arrived with a splash; although largely dissipated when contact was made, it still left a drop sufficiently large to trickle down the plate when tilted. The splash and the direction taken by the remainder of the liquid are both faithfully recorded by the wild yeasts that the drop contained—Fig. 39.

Fig. 39

F. A. M

Carbolineum Washes for Winter Spraying

SINCE the recent introduction of tar oil washes for winter spraying, the control of insect pests has been placed upon a much sounder basis than was possible when growers were restricted to the use of the old, weak, alkaline and sulphur compound washes. This is due mainly to the powerful ovidical, and to a less extent the larvicidal properties of the compounds used in the preparation of Carbolineum Washes. By reason of the effect of these substances on soft plant tissue the trees can be freed from growths of moss and lichen much more thoroughly than was formerly the case, and this destruction entails also that of the eggs of insects and hybernating imagos which have hitherto been securely protected by these vegetable structures.

The degree of insect infestation in the spring is often reflected in the amount of damage done later on by fungous disease organisms; although, of course, there are many factors in the spread of fungous diseases other than that of insect relationship, the latter is of grave importance, and the greater the number of insects, the greater the variety and abundance of fungous infection. It follows, therefore, that effective winter washing controls to a very appreciable extent the degree of subsequent attack by fungi.

In view of the results of our own experiments and observations as well as of the more public trials of various Carbolineum Washes, we were glad of the opportunity presented by the courtesy of the Horticultural Superintendent of Flintshire of having Mortegg tested alongside other washes for its applicability to the horticultural requirements of North Wales, and the following notes are based upon the report on "Winter Spraying of Fruit Trees with Carbolineum Washes" by Harry L. Jones, N.D.H., published in the *Welsh Journal of Agriculture*, Vol. III, 1927, p. 298. The trees were sprayed at each centre, with one exception, by the second week in January. At one centre, owing to circumstances which could not be avoided, the trees were not

sprayed until the 17th of February, the owner being warned that damage to the trees might result from the application of the spray so late in the season. As, however, he was anxious to find out whether it was possible to control plum aphis, he decided to have some of the trees sprayed, leaving the remainder as controls. At each of the other centres a number of trees were likewise left unsprayed for this purpose. At each of the centres chosen the trees had been very severely attacked by various pests in previous years.

At Caerwys, apples and gooseberries only were sprayed; at Cilcen Hall, Mold, pears, apples, plums and peaches; at St. Asaph, apples, pears, peaches, plums, cherries and apricots; at Hanmer, plums and apples only were sprayed; and at Bangor and Llanrug, apples only were sprayed. At each centre the wash was applied at $7\frac{1}{2}$ per cent. concentration.

Several makes of Carbolineum Washes were used in the tests at different centres. The following is the report on Mortegg after trials at the County Council Demonstration Orchard, Wernfawr, Caerwys:—

> Elevation, 600-650 feet. "Mortegg" applied January 12th, 1926; inspected April 26th and June 8th, 1926.
>
> Sixty young apple trees and six plums were sprayed, one of each variety being left as controls. One hundred and twenty gooseberries, and six left as controls. Orchard very badly infested with aphides in 1924-25.
>
> *Apples.*—A few aphides were present on one or two trees at first visit. Psylla: None seen on the sprayed trees, several seen on controls. Winter moth larvæ numerous on all trees, both sprayed and unsprayed.
>
> This orchard was late and a second inspection was made on June 8th.
>
> *Apples.*—Only one or two aphides were seen on the sprayed trees; the unsprayed were rather badly infested, and after a lead arsenate spray the trees were making a clean and vigorous growth.

Gooseberries.—Were making clean and vigorous growth.

Plums.—A few leaves were curled by *Aphis prunina.*

General impression : Good.

Mr. Jones' conclusions with regard to the results of these trials are as follows :—The carbolineum winter washes are most certainly a great advance on any winter wash he has hitherto used, in some cases a single spraying effecting control of such pests as leaf-curling aphis, psylla and also mussel scale. Control of winter moth and other larvæ cannot be relied upon. Although the application of the spray at Credington Gates* resulted in a complete control, such a late application of the spray is not recommended, and the trees must be absolutely dormant when the spray is applied or damage to the buds may occur. For the control of winter moths it is recommended to spray the trees with lead arsenate after the blossom falls, at the rate of 1 lb. to 20 gallons of water, whilst in the case of standard trees grease banding is also recommended.

In all cases the various sprays were applied at 7½ per cent. concentration, and Mr. Jones believes it is possible to apply concentrations up to 10 per cent. on apples and plums if this is done when the trees are absolutely dormant. Plums should not be sprayed if there are any signs that the buds are breaking—to do so is to court failure, as it will undoubtedly cause failure.

All brands of carbolineum washes do not give equally good results, or at least do not give perfect control of insect pests. All of them cleanse the trees of lichen and moss, and as far as can be seen no harm was done to the trees sprayed, as all those sprayed appeared to make a far more vigorous growth than the controls.*

The differences in the effect of carbolineum compounds from different sources as noted above are strikingly brought out in the Reports of F. R. Petherbridge, W. A. R. Dillon Weston and S. G. Jary on " Trials of Tar-Distillate Washes " in East Anglia and the West Midlands respectively, published in the *Journal of the Ministry of Agriculture*, July, October and November, 1926,

* This refers to a carbolineum wash applied so late in the winter as Feb. 15th.

and from which the following tables are abstracted. For fuller information, reference should be made to the original Reports.

Experiments in Cambridgeshire were carried out in an orchard belonging to Mr. W. Unwin, of Histon, in which spraying was begun on February 12th, 1925, with eleven proprietary washes, of which Mortegg was one. A headland pump, working two nozzles adjusted to give a coarse spray, was employed. There were three rows of plums and three of apples, arranged as follows :—

> "Rivers" Plum, "Chivers" Seedling Apple, "Allington" Pippin (this variety for half the length of the row, the remainder being "Jolly Miller"), "Sterling Castle" and two rows of "Victoria" Plums.

There were fifteen plots, each plot being two trees deep across the six rows mentioned above, or twelve trees per plot, except in two cases where the plots contained three rows of trees. Appropriate controls were left. Observations were kept on these plots throughout the season and estimations of the amount of leaf curl caused by aphides and the damage caused by caterpillars were made.

Beside these estimations, an analysis of the insect population of the trees in the various plots was made in May by holding a beating tray underneath the trees as they were jarred and shaken. The approximate numbers of the various pests present on the tray were then tabulated. In Table 1, col. i, will be found the percentage of leaves curled by aphis on trees sprayed with the various washes.

Experiments in Essex were conducted on the estate of Messrs. W. Seabrook & Son, Ltd. These consisted in the application of six different washes on February 26th-28th; the

* This effect upon the foliage and general vigour of trees sprayed with Carbolineum Washes is frequently commented upon by other users, and special reference to this point is made in the Report of F. R. Petherbridge and W. A. R. Dillon Weston, mentioned in the succeeding paragraph. These authors state that the trees on sprayed plots at Wisbech all carried much more foliage than the trees on the unsprayed plots, and that their appearance suggested much better prospects of a crop next year. They give figures indicating that the area of 500 leaves (Bramley) from an unsprayed tree was 18,692 square centimetres; spraying with each of three proprietary washes resulted in a much increased leaf area, the average of the three calculating out at 26,190 square centimetres for 500 leaves.

general arrangement of this series was as follows:—

In the block of trees taken there were ten rows, all apples, the varieties being "Cox's Orange Pippin" (5 rows), "Worcester Pearmain" (4 rows), "Devonshire Quarrenden" (one row). Only the alternative rows were sprayed, the intervening rows serving as efficient controls, and ensuring that there was no risk of one spray being accidentally blown upon the trees sprayed with another wash. Observations and estimates were made by Mr. R. Hart and Mr. H. Fraser, from April 9th to May 11th, 1925.

One mark was recorded for a small amount of aphis or caterpillar; two marks where aphis or caterpillar were easily found; three marks where the tree was badly infected with either aphis or caterpillar. The caterpillar figures refer chiefly to winter moth caterpillars and not Tortricids. The results are tabulated in Table I, col. ii, for aphis damage, and Table II for caterpillar damage.

Table I.

SHOWING THE RELATIVE ATTACK OF APHIS.
(PETHERBRIDGE AND WESTON.)

SPRAY TREATMENT. Per cent.	(i) CAMBS (PLUMS) Sprayed Feb. 12, Amount of Leaf Curl caused by Aphis	(ii) ESSEX (APPLES) Sprayed Feb. 26-28, Intensity of attack of Rosy Apple Aphis
Carbokrimp, 7½	None. Very few	1†
Chafers No. 1 Winter Wash, 10 ...	None	—.
C. Ialine Tar Oil Winter Wash, 3½	Few	—
Mortegg, 7½	None. Very few	1
A, 7½	Few	12
B, 7½	2-3 per cent. ...	17
C, 5	5 „ ...	15
D, 5	5 „ ...	—
E, 3¼	5 „ ...	—
F, 7½	20-25 „ ...	—
G, 7½	35-40 „ ...	26
Untreated	25-45 „ ...	30 (Maximum)

† At 10 per cent.

Table II.

Relative Extent of Caterpillar (Winter Moth) Damage in Essex. (Petherbridge and Weston.)

Spray Treatment (Feb. 26-28, 1925) Per cent.	Intensity of Attack
Carbokrimp, 10	2
Mortegg, 7½	2
A, 7½	11
B, 7½	11
D, 7½	10
G, 5	5

In the West Midlands large scale experiments were carried out under the supervision of S. G. Jary, B.A. (Advisory Entomologist, West Midland Province), during 1925 and 1926. He used five brands of carbolineum wash on trees never previously sprayed with washes of this type, and each was used at two strengths, viz., 4 per cent. and 8 per cent. respectively.

In 1925 eight orchards, denoted in the following tables by the letters A, B, C, were sprayed, and the results tabulated. The system of marking is as follows:

10 = heavy attack.
5 = a moderately severe attack.
1 = a very slight attack.

Intermediate figures have corresponding values.

The dates of spraying fell between January 27th and February 16th. The trees were examined between April 27th and April 29th except in the case of the Damsons, which were examined at that date and subsequently on May 15th and June 9th.

"KING OF DAMSONS" SPRAYED WITH MORTEGG, JANUARY 12TH, PHOTOGRAPHED JUNE 27TH.

"KING OF DAMSONS" NOT SPRAYED WITH A WINTER WASH, PHOTOGRAPHED JUNE 27TH.

Table III.

1925 Trials. Apples. (S. G. Jary.)

Wash at 8 per cent. strength.

Wash	Aphis					Psylla					Caterpillar					Capsid				
	Orchard				Av.	Orchard				Av.	Orchard				Av.	Orchard				Av.
	A	B	F	G		A	B	F	G		A	B	F	G		A	B	F	G	
Control ..	5	8	6	5	6	—	4	2	—	3	3	6	8	1	4·5	—	6	—	—	6
Carbo-krimp .	0	3	0	0	·7	—	1	0	—	·5	0	2	2	1	1·2	—	3	—	—	3
Wash X .	2	7	5	1·5	3·9	—	4	1	—	2·5	5	4	4	1	3·5	—	0?	—	—	0?
Mortegg .	1	1	0	0	·5	—	1	0	—	·5	0	1	1	1	·7	—	1	—	—	1
Wash Y .	0	1	1	0	·5	—	1	0	—	·5	1	2	3	1	1·7	—	0	—	—	0
Wash Z .	1	2	2	1	1·5	—	1	1	—	1	4	2	6	1	3·2	—	0	—	—	0

Table IV.

1925 Trials. Apples. (S. G. Jary.)

Wash at 4 per cent. strength.

Wash	Aphis					Psylla					Caterpillar					Capsid				
	Orchard				Av.	Orchard				Av.	Orchard				Av.	Orchard				Av.
	A	B	F	G		A	B	F	G		A	B	F	G		A	B	F	G	
Control ...	5	8	6	5	6	—	4	2	—	3	3	6	8	1	4·5	—	6	—	—	6
Carbo-krimp ..	0	4	0	0	1	—	1	1	—	1	1	3	4	1	2·2	—	3	—	—	3
Wash X ..	6	7	7	4	6	—	5	1	—	3	1	4	6	2	3·2	—	0?	—	—	0?
Mortegg ..	0	2	0	3	1·2	—	1	0	—	·5	0	3	3	2	2	—	2	—	—	2
Wash Y ..	0	5	1	0	1·5	—	1	1	—	1	1	4	4	1	2·5	—	1	—	—	1
Wash Z ..	2	6	4	2	3·5	—	1	1	—	1	1	4	6	2	3·2	—	2	—	—	2

Table VI.

1926 Trials. Apples. (S. G. Jary.)

NOTE.—In the table below the figures under—

Winter Moth Caterpillars and Tortrix Caterpillars represent the actual number of caterpillars on the average per tree.

Apple Sucker (*Psylla mali*), *Aphis pomi and Aphis roseus* indicate the intensity of attack, a figure of 10 being awarded for a very heavy attack with gradations down to 1, which shows a very slight attack.

Capsid indicate the percentage of leaf trusses on the tree showing the markings made by this bug.

In all cases where only a very occasional insect was found the abbreviation "Tr." is used, indicating "a trace."

Wash		Winter Moth Caterpillars				Tortrix Caterpillars				Psylla				Aphis pomi				Aphis roseus				Capsid			
	Strength	A	B	C	Av.	A	B	C	Av.	A	B	C	Av.	A	B	C	Av.	A	B	C	Av.	A	B	C	Av.
	per cent.																								
Mortegg	10	1·5	2·5	10	4·7	·5	—	—	—	—	—	—	—	—	—	·6	·2	—	—	—	—	2–3	—	—	—
	8	2·29	3·8	8	4·7	1	—	—	—	—	—	—	—	—	Tr.	·4	·14	—	—	—	—	12	—	—	—
	4	4	7	20	10·3	2·5	—	—	—	—	—	—	—	—	Tr.	·3	·1	—	—	—	—	33	—	—	—
Carbokrimp	10	2·5	4·4	5·5	4·1	·5	—	—	—	—	—	—	—	—	—	·12	·04	—	—	—	—	2–3	—	—	—
	8	1·5	4·1	18	7·9	1	—	—	—	—	—	—	—	—	Tr.	·16	·06	—	—	—	—	20	—	—	—
	4	7	9·5	18	11·5	4	—	—	—	Tr.	—	—	—	—	Tr.	2	·6	—	—	—	—	33	—	—	—
Control ...	—	30	14	66	36·6	10	—	—	—	Tr.	2	—	—	Tr.	4	6	5	Tr.	—	—	—	33	—	—	—

Table V.

1925 Trials. Plums and Damsons. (S. G. Jary.)

Wash	Wash at 8 per cent. strength								Wash at 4 per cent. strength							
	Aphis				Caterpillar				Aphis				Caterpillar			
	Orchard			Av.	Orchard			Av.	Orchard			Av.	Orchard			Av.
	C	E	G		C	E	G		C	E	G		C	E	G	
Control ..	10	2	5	5·6	—	3	1	2	10	2	5	5·6	—	3	1	2
Carbo-krimp .	2	0	0	·6	—	1	1	1	3	0	0	1	—	1	1	1
Wash X .	6	0	1·5	2·5	—	2	1	1·5	5	1·5	4	3·5	—	2	1·5	1·8
Mortegg .	3	0	0	1	—	1	1	1	2	0	3	1·7	—	1	0	·5
Wash Y .	1	0	0	·3	—	1	1	1	5	1	0	2	—	1·5	0	·7
Wash Z .	6	1	1	2·6	—	1·5	1	1·2	3	1·5	2	2·2	—	2	1	1·5

Further tests were made by Mr. Jary in 1926, using only the two washes found effective in 1925, and with a view to ascertaining the possibilities of controlling Capsid Bug (*Plesiocoris rugicollis*) by means of these washes a spray at a strength of 10 per cent. was included. As six different fruit tree pests were concerned in the tabulation of results the following tables give much useful and interesting information.

Table VII.

1926 Trials. Plums and Damsons. (S. G. Jary.)

NOTE.—In the table below the figures under—

Aphis show the percentage of leaves on the tree which were curled.

Caterpillar represent the actual number of caterpillars on the average per tree.

Wash	Strength per cent.	Aphis. Percentage of Leaves Curled			Winter Moth Caterpillars. Number
		C	D	Av.	C
Mortegg	10	·4	Tr.	·2	7
	8	·3	Tr.	·15	7·9
	4	·3	·6	·45	24
Carbokrimp ...	10	·27	1·6	1·6	10
	8	·19	4	2·1	11·3
	4	2	2·6	2·3	18
Control	—	90	60–70	75	200

Mr. Jary concludes from his trials extending over two years that the eggs of Aphides, Apple Sucker, Winter Moth and Tortricids are killed by these washes at 4 and 8 per cent., but a concentration of 10 per cent. is considered most effective and is also far more deadly against Capsid bugs. In no case has any damage been observed to buds sprayed with 10 per cent. provided that the trees are dormant at the time of application.

In addition to the foregoing official trials, numerous experiments with Mortegg have been privately conducted, several of which may be instanced:—

Apples and Damsons.

Two years ago Dr. T. Wood-Locket, M.A., M.B., B.Ch. (Cambs.), The Holme Estate, Brutton, Wiltshire, carried out trials with Mortegg at different strengths, leaving certain trees unsprayed as controls. It was found that not only were the sprayed trees clean and free from pests, but also that they are making more vigorous growth than previously. Through the courtesy of Dr. Wood-Locket we are permitted to publish four photographs from his own negatives in illustration of the effects of spraying. (Plates vii, viii, ix & x).

Apples for Cider Purposes.

H. Whiteway, Esq., Whimple, Exeter, reports on the efficacy of Mortegg, and states that the effects have been most striking in many respects. Messrs. Pullin Bros., Apple Growers and Cider Makers, corroborate this view with regard to orchards planted since the War; and on old trees, especially on the celebrated Cider Apple, "Kingston Black," the fruit is excellent.

Apples, Plums and Pears.

E. G. Davison, Esq., Croxton Fruit Farm, St. Neots, Huntingdon, has made careful notes of the results obtained with the same material. In the case of one plot, although there was rain half-an-hour after spraying, there was no trace of aphis or apple sucker on the trees during the season, nor was it necessary to spray against caterpillar. Using Mortegg at various strengths, Mr. Davison has obtained absolute control at 4 per cent. On an unsprayed control plot it was necessary later in the year to spray twice against many pests without entirely eradicating them.

"NEWTON WONDER" SPRAYED WITH MORTEGG, JANUARY 12TH, PHOTOGRAPHED JULY 15TH.

"NEWTON WONDER" NOT SPRAYED, PHOTOGRAPHED JULY 15TH.

Miscellaneous Fruits.

During the winter of 1926, W. M. Gower, Esq., Mill Hill Gardens, South Walsham, Norfolk, sprayed upwards of twenty acres of Apples, Pears, Plums, Gooseberries, Red Currants, Black Currants and Raspberries with great benefit to all. He remarks specially upon the perfectly clean and fine crop of Black Currants, of which there are over ten acres on his estate. Here also the foliage was particularly healthy, growth making striking contrast with former conditions.

In order to obtain maximum benefits from the use of Mortegg and other carbolineum washes several points require special attention. It is essential that spraying operations should be carried out on dormant trees, and furthermore at a time when the tree is dry; the amount of water on a wet tree is often sufficient to reduce the strength of the spray to an unsafe limit. The whole tree should be sprayed, with careful attention to the tips of shoots where insect eggs are commonly deposited: ideal conditions for spraying include a quiet atmosphere, dry weather, an absence of frost, with no likelihood of rain for at least twelve hours; the wash should be sprayed from a coarse nozzle which will ensure the thorough wetting of the trunk, boughs and twigs, a procedure which amounts practically to washing on the solution.

Apples, Pears, Plums and Cherries should be sprayed with Mortegg at a maximum strength of 10 per cent., and at this strength only if the trees are exceptionally dirty and much infested with caterpillar and capsids. A strength of 7½ per cent. is the best for general work, and at this dilution it is effective in the control of psylla (apple sucker) and aphis. The bush fruits, Black and Red Currants and Gooseberries, do not as a rule require more than 6 per cent., and at a strength of 5-6 per cent. Vines and Peaches have been freed from mealy bug, red spider and scale insects. Woolly aphis and pear midge in the soil appear to be controlled by Mortegg sinking into the ground.

It has been found that in order to regulate the physical conditions of the spraying solution it is necessary when diluting Mortegg to add the proper proportions of water to the material, and not Mortegg to the water, and instructions to this effect are issued to users.

F. A. M.

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FIVE GRAINS SO_2 PER GALLON
are ample if your plant and premises
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DRY INSECTICIDE POWDER

(FAMILIARLY KNOWN AS D.I.P.)

Guaranteed Free from Arsenic

POWDERING or dusting Hops to control Blight is annually becoming more popular because of the many obvious advantages.

In a year when Blight is sudden in its appearance, the Grower who can quickly cover his acreage with an efficient Insecticide scores over his less fortunate neighbour, for without question, Dusting is unequalled for quickness and ease of application.

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Again, the labour costs are incomparably lower where Dusting is performed as against Washing.

ALVESCO D.I.P. is *not* the cheapest Dust on the market when looked at from the cost per ton point of view, but we say without hesitation that D.I.P. *is* the cheapest Dust obtainable when considered on cost per acre treated, as 14 lbs. will treat an acre of 7 feet Hops.

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COMBINED HOP WASH

MANY Hop Growers prefer to use a Hop Wash that has both Insecticidal and Fungicidal properties, as by so doing one washing is made to serve the double purpose of the ordinary "Blight" Wash and the application of Flowers of Sulphur.

In **"ALVESCO" COMBINED HOP WASH** the Grower is offered a preparation that has only been placed upon the market after very considerable research work has been extended upon it, and he has the satisfaction of knowing that while the Wash is completely effectual in controlling "Blight" the fungicide ingredients will be efficacious in controlling Hop Mould.

Certain Hop Washes "harden" the growth of the Hop Bine owing to the resinous bodies contained in them. In this particular Wash everything of this nature has been completely barred, and it will be found that the Bine grows away freely after each application.

The dilution advised is 1½ glns. to 100 glns. of water, the spray to be applied with as much force as is reasonably obtainable, for, although the Wash has excellent spreading properties, it is essential to use force to thoroughly wet the " Blight."

Wherever used during 1926 this Wash was very highly spoken of.

An excellent Wash where Red Spider has to be controlled.

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BRITISH TAR DISTILLATE WINTER WASH

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